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Procedia Engineering 150 (2016) 2062 – 2066

Procedia Engineering

www.elsevier.com/locate/procedia

International Conference on Industrial Engineering, ICIE 2016

The Decision of Tasks of Estimation of the State Automotive-Road Service System

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Abstract

The system of roadside service drivers and passengers is a set of enterprises for the production of services. Therefore, the basis for its rational development should be the method of the multi-variant architectural planning, design, organizational solutions, the range of services provided, and, by analyzing these services in different combinations, you can get the most rational traffic services system, that is very important both at the stage of design and construction and in the operation of buildings and facilities. The results of theoretical and experimental studies evaluating the state automotive-road service system using sociological methods, the analytic hierarchy process, and the fuzzy set theory to meet the challenges of its efficient organization.

Peer-review under responsibility of the organizing committee of ICIE 2016

Keywords: road service; automotive-road service; architectural planning; design; quality of roadside service; indicator of quality; membership function; the level of quality.

1. Introduction

Due to the growth of car ownership, the increase in the volume of road transport and mobility of the population there was a serious problem of providing a safe and comfortable passengers and drivers life activity in transit. The work of road transport complex cannot be achieved without the development of roadside infrastructure and services, which in turn must comply with current standards for quality assurance [1].

Road service - a complex of buildings and structures, which provides normal life conditions of drivers and passengers, as well as efficiency maintenance of vehicles [2]. The system of roadside service drivers and passengers

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Peer-review under responsibility of the organizing committee of ICIE 2016
doi:10.1016/j.proeng.2016.07.303

is a set of enterprises for the production of services. Therefore, when considering the assessment of the quality service of automotive-road management techniques roadside service would allow to organize a system of enterprises and roadside service facilities most efficiently, thereby reducing costs as a result of the low level customer service [3-7].

2. Research Methodology system automotive-road service

The need for making the choice of the rational organization of road service system arises both at the stage of design and construction and in the operation of buildings and facilities of roadside service with the provision of essential services to passing on the road.

One way of solving problems of this type is a quantitative assessment of the various options (alternatives) and selection of the most efficient. Very often the quantity assessment is very difficult [8-13]. In this regard, in recent years, along with objective measurement methods are widely used methods of sociology and expert methods of statistical quality control and management methods [14,15]. In addition to organization-level decision analysis problems of roadside service system it is advisable to use the mathematical apparatus: the theory of probability, mathematical statistics, methods of systems analysis [16], analytical planning (Analytic Hierarchy Process) [17-20], theory of fuzzy sets [21].

The issue of improving the system auto-road service and the development of road infrastructure related to the solution of problems of socio-economic, institutional and scientific plan. The use of logistics and system approaches, systems analysis, taking into account the large number of factors that are related between themselves within the system, as well as with environmental elements, as well as methods of sociology, providing the ability to measure the subjective assessment of consumers, their opinions and attitudes towards the quality of roadside service It allows for a deep analysis of the state of the system auto-road services, to develop a strategy for its development, improve the quality of services, and as a consequence to ensure the effective and safe operation of road-transport complex [1].

The proposed method of quality assessment of roadside service includes the following steps:

- definition of goals and objectives of the study; selection of quality evaluation indicators;
- information obtained by sociological research methods and registration;
- data processing;
- determination of the selected criteria weight quality value assessment using the hierarchy analysis;
- quantitative evaluation of particular indicators;
- calculation of the complex quality index of the research object considering weight criteria;
- alternative solution selection.

Under the proposed procedure assessment of roadside service was conducted in the Volgograd region, which allowed us to estimate quality of the system and select types of businesses and services most appropriate to meet the needs of drivers and passengers [22, 23].

As a result of a consumer poll a set of linguistic variables, characterizing the importance (a measure of the desired level), and satisfaction with the quality traffic services, such as "fully satisfies", "satisfies the most ","does not meet the more likely", "does not satisfy", "very important", "somewhat important", "not more important", "it does not matter" was received. "The degree of compliance can be characterized by the following linguistic terms: "high", "medium", "below average", "low".

Studying the importance and satisfaction with the roadside service quality, which was used by respondents was accepted rating scale from +1 to -1, from which derived indices "importance" and "satisfaction". A positive value of the index was assessed as "important" and "satisfaction" the quality of services, a negative value as "Important" and "dissatisfaction". Total estimates for the respondents were offered 16 kinds of criteria of quality of roadside service (Fig. 1).

Fig. 1. The Indices of "importance" and "satisfaction" of drivers and passengers quality indicators roadside service
1-reliability and quality of services; 2-technological equipment; 3-time expectations of service performance; 4-ease of entry and exit; 5 additional services; 6-availability of parking space and availability; 7-availability of suitable locations standby services or transport; 8-compliance with health standards; 9 affordable prices; 10 competence, professionalism of staff; 11 culture of service; 12 Design of architectural environment of the object; 13 appeal of the interior; 14, the presence of audio-video equipment; 15 security companies; 16 and information support.

System of vehicle maintenance enterprises (Table 1) - As a result of the calculation using the analytic hierarchy process (AHP) [17] vectors of global priorities for the consideration of the functional group of objects auto-road service have been received

Table 1. Vectors of global priorities of the functional group of objects auto-road service

Types of objects	The values of the weights vector of global priorities
Car-service station (universal car repair sector)	0,149
Car-service station (Specialized car repair sector)	0,072
Tyre, balancing	0,089
Rapid diagnosis of Transport	0,109
Paragraph minor repairs on their own	0,062
Filling station	0,080
Car Wash	0,087
Shop "Auto Parts"	0,125
Complexes of objects of road service	0,228

The greatest weight is an alternative - complexes of objects of road service - 0.2. This means that the group of the surveyed drivers preferred the company service centers as part of roadside service facilities. The study revealed that the following objects of roadside service and technical purposes require priority development, received the greatest weight: Car-service station (universal car repair sector), weight is 0,149; Stores «Parts" (0.125); rapid diagnosis of Transportation (0.109).

For compliance estimation with a sufficient degree of approximation can be used a term of membership [21], which is the basis of fuzzy set theory. Suppose X - a fuzzy set of properties, features or options. This set can be associated with the fuzzy set N, which is described by the fuzzy variable x and its membership function $\mu_N(x)$. Formally, the fuzzy set can be represented as:

$$N = \{(x, \mu_N(x)) : x \in X, 0 \le \mu_N(x) \le 1\}, \quad (1)$$

where x - possible values of the fuzzy variable in a predetermined region X;. $0 \le \mu_N(x) \le 1$

The concept of degree of membership is similar to the concept of probability, μN(x2)=1 so means that x_1 does not belong to N, and μN(x2)=1 the evidence of reliable supplies x2 to the set N, the upper limit corresponds to

μN(x)=1. As a rule, the membership function $\mu_N(x)$ is given by experts on the basis of information on the uncertainty of variable sources.

To describe the qualitative status of roadside service system integrated function has been selected:

$$K = \prod_{i=1}^{16} S_i^{\alpha_i}, \qquad (2)$$

where α - the weight of the private exponent;

S_i - numerical values of the partial indicators on the degree of realization.

The values of the indicators included in this function are obtained from observations with the introduction of the variables in the expression (2) to assess the level of quality of roadside service turns a certain value the quality of roadside service. The higher the value of K, the higher the level of service quality. However, it should tends to a certain optimum level of service.

The selected membership functions are of the form $\mu_{N1} = 1/e^{5|x|}$; $-1 \le x \le 1$ and $\mu_{N2} = 1/e^{5|x-0,5|}$; $0 \le x \le 1$, graphs thereof are shown in Fig. 2.

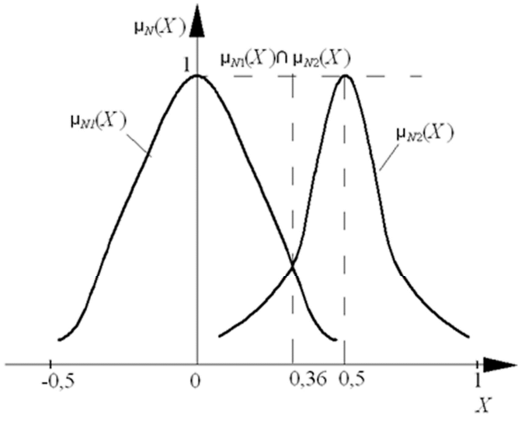

Fig.2. Plots of the function accessories to determine the extent of compliance

The maximum function is $\mu_N = 1/e^{|x-0,5|}$ achieved at x = 0,5. Given that the interval [0; 1] is split a maximum point, and the lower and upper limit of the range correspond to K = 0,39 and K = 1,0, obtain $K = (0,39 + 1,0)/2 = 0,696$ or 69.6%. The resulting value represents the quality of roadside service drivers and passengers the most appropriate (rational) for the consideration of conditions and the state of the system automotive-road service.

By using the theory of fuzzy sets to solve the problems of the state assessment system of roadside service drivers and passengers defined level of quality achieved by 36%, which indicates a low level and its non-conformity to the desired.

3. Conclusions

The proposed in the article the method allows to produce a comprehensive quantitative assessment of the quality level, to determine the level of state road service system in the Volgograd region and choose the rational development option.

It is universal and can be used in various spheres of human activity (construction, transportation, trade, service, etc.), in general, where it is necessary to consider the "human factor" (the opinion of consumers, decision-makers).

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